A 12-year-old American Saddlebred gelding was referred to the Washington State University Veterinary Teaching Hospital for evaluation of a chronic lameness problem that had been localized to the right radiocarpal joint. Lameness attributed to arthritis of the radiocarpal joint had been evident for 3 years. Signs of lameness resolved after intra-articular injections of cortisone, which had been repeated multiple times during this period. The horse had not responded to a cortisone injection 3 weeks prior to admission. The lameness had become worse and was severe at times. Radiography of the right carpus by the referring veterinarian revealed a large cyst-like abnormality in the distal portion of the radius.

On physical examination, the horse had marked enlargement of the right radiocarpal joint. The horse was moderately lame in the right forelimb at a walk and was severely lame (scale, 3/5) when trotted over a smooth hard surface. A carpal flexion test revealed that the horse was resistant to and had signs of pain with carpal flexion. The carpus could only be flexed to 50% of the normal range. The horse's lameness was worse (scale, 4/5) after carpal flexion.

Radiography of the right carpus revealed a 2 X 3-cm lytic defect in the palmarodistal aspect of the radius and periarticular bone proliferation of the radiocarpal joint on the lateral and dorsopalmar views (Figures 1 and 2). The lytic area had a sclerotic border and appeared similar to a subchondral cyst.

Computed tomography (CT) was used via general anesthesia to determine the location of the lytic defect and its relationship to the radiocarpal joint. The CT scan revealed a defect located on the caudodistal aspect of the radius; a communication to the weight-bearing articular surface of the radius was not observed (Figure 3). A large area of bone lysis was observed on the palmar aspect of the distal portion of the radius. Periarticular bone proliferation and lysis were observed on the proximal surface of the accessory carpal bone, lateral aspect of the ulnar carpal bone, and palmar aspect of the radial carpal bone. Ultrasonographic evaluation of the palmar aspect of the distal portion of the radius revealed excessive soft tissue in the joint space and cavity, the cause of which could not be determined.

Arthrocentesis of the right radiocarpal joint was performed after the skin was aseptically prepared, and synovial fluid was submitted for cytologic examination and bacteriologic culture. The synovial fluid sample was taken prior to surgical exploration. Synovial fluid

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**Septic arthritis and granulomatous synovitis caused by infection with *Mycobacterium avium* complex in a horse**

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*Mycobacterium avium* complex may cause granulomatous lesions in various tissues of affected horses

Although rare, infection with *Mycobacterium avium* complex may also cause septic arthritis and granulomatous synovitis
analysis revealed a mixed inflammatory response, high protein content (6.0 g/dL), and mildly high WBC count (1,430 cells/µL) with 59% small and medium lymphocytes, 22% neutrophils, and 19% large lymphocytes. No organisms or neoplastic cells were seen. The findings prompted a diagnosis of lymphocytic synovitis resulting from chronic osteoarthritis. No bacterial growth was detected via routine aerobic and anaerobic culture.

Arthroscopic surgery was performed on the right radiocarpal joint by use of a dorsal approach. Before surgery, the horse received phenylbutazone (4.4 mg/kg [2.0 mg/lb], IV, q 12 h, twice), potassium penicillin G (22,000 U/kg [10,000 U/lb], IV, q 6 h, twice), and gentamicin (2.2 mg/kg [1.0 mg/lb], IV, q 8 h, twice). The horse was sedated with xylazine (0.7 mg/kg [0.3 mg/lb], IV), and anesthesia was induced with concentration guaifenesin (400 mL, IV), ketamine (2.2 mg/kg, IV), and diazepam (0.05 mg/kg [0.023 mg/lb], IV). Anesthesia was maintained with isoflurane.

The horse was positioned in left lateral recumbency. Arthroscopy revealed marked synovial proliferation with a large amount of fibrin in the dorsal aspect of the joint. The joint was lavaged, and the fibrin was removed with Ferris-Smith pituitary gland rongeurs. After removal of the fibrin, the articular cartilage surfaces could be evaluated. The articular surface was intact with only mild, partial-thickness abnormalities seen in the cartilage. A communication with the cystic defect in the distal portion of the radius was not found, even when the joint was maximally flexed to evaluate the palmar aspect of the joint. The incisions into the radiocarpal joints were closed with simple interrupted sutures with 2-0 polypropylene.

A palmar arthrotomy into the radiocarpal joint was performed. The palmar pouch was identified proximal to the accessory carpal bone. A 3-cm incision was made with a No. 11 blade on the lateral aspect of the palmar pouch through the skin, subcutaneous tissue, and joint capsule palmar to the distal radius. By use of Ferris-Smith pituitary gland rongeurs, the thickened synovium and fibrin were removed. The defect in the distal portion of the radius, previously identified on CT images, was filled with a soft tissue-density mass that was removed with pituitary gland rongeurs, Kelly tissue forceps, and curettes. After most of the excess tissue was removed, the palmar pouch was flushed with sterile saline (0.9% NaCl) solution and the arthrotomy incision was closed in 3 layers. The abnormal synovium and tissue were submitted for histologic examination and bacteriologic culture. Tissue for histologic examination was fixed in neutral-buffered 10% formalin. Microscopic examination of H&E-stained sections revealed diffuse, severe, chronic, granulomatous, and fibrinous synovitis with multinucleated giant cells (Figure 4). Possible causes for the observed pathologic changes included chronic bacterial infection (Mycobacterium spp or saprophytic filamentous bacteria such as Actinomyces or Nocardia spp); fungal infection; or persistent, nonsoluble, intra-articular foreign material. Special stains (Kinyoun acid fast, Ziehl-Neelsen acid fast, Grocott methenamine silver, and Gram) performed on the abnormal synovium
from to grow in 21 days allowed differentiation of Mycobacterium visiblis, which is required for the ability of the isolate to grow without mycobactin, distinguishing it from other closely related species. Although this sequence does not distinguish between Mycobacterium avium complex and other closely related species such as Mycobacterium paratuberculosis, it was used for the primer because of its effectiveness in differentiating between these species. The use of the 344-base pair segment for the primer allowed the differentiation of Mycobacterium visiblis from other species, allowing for more accurate identification.

Mycobacterium visiblis was isolated from synovial fluid obtained at surgery and confirmed via culture. The horse was treated with systemically active antimicrobials to address the mycobacterial infection. Post-surgery, the horse showed improvement in lameness and swelling.

**Fig. 4**—Photomicrograph of a portion of the synovium from the right carpus of the horse in Figure 1. Notice synovial inflammatory infiltrates consisting predominately of macrophages (thick arrow), occasional lymphocytes (thin arrow), and multinucleated giant cells (M). H&E stain. Bar = 32 µm.

Additional bacteriologic cultures of the synovium and synovial fluid yielded a few colonies of an acid-fast, filamentous bacterial rod at 21 days after inoculation on Middlebrook agar (without additional components, additives, or enrichments; incubation at 35°C in 5% CO₂ atmosphere), which is used to grow Mycobacterium spp. The isolate from both samples was identified as Mycobacterium avium complex by sequencing a 344-base pair segment of the 16S rDNA gene, which was amplified via polymerase chain reaction with genus-specific primers. Sequence identity was confirmed by searching the GenBank database (National Center for Biotechnology Information), which indicated that the isolate shared 100% sequence identity with M. avium. Use of the 344-base pair segment for the primer allowed differentiation from Mycobacterium kansasii, Mycobacterium visiblis, and other closely related species of mycobacteria. Although this sequence does not distinguish M. avium from Mycobacterium paratuberculosis, the ability of the isolate to grow without mycobactin, which is required for M. paratuberculosis, and the ability to grow in 21 days allowed differentiation of M. avium from M. paratuberculosis.

The horse was treated with phenylbutazone (4 mg/kg [1.8 mg/lb], PO, q 24 h) and was kept in a full-limb, padded compression bandage for 14 days after surgery. The sutures were removed 12 days after surgery, prior to discharge from the hospital. The horse's lameness was markedly improved after surgery, and the horse was walking normally at the time of release from the hospital. Swelling in the radiocarpal joint had decreased, and the horse had 75% of normal flexion of the carpus.

One week after returning home, the horse had a recurrence of clinical signs with severe lameness, high rectal temperature, and swelling around the radiocarpal joint. The horse was treated with systemically active antimicrobials (penicillin [22,000 U/kg, q 12 h] and gentamicin [4.4 mg/kg, q 24 h]) for several days. Because of failure to respond, the expense of further treatment, and a poor prognosis for future soundness in a gelding, the horse was euthanized. Additional diagnostic tests and postmortem examination were not performed.

Septic arthritis is a common problem in horses. 5,6 In adult horses, infection occurs after bacterial contamination of a synovial structure from an adjacent wound, a joint injection, or a surgical procedure. Common isolates from septic synovial structures include Enterobacteriaceae, Streptococcus spp, and Staphylococcus spp.6,8 Mycobacterium spp were not isolated from any synovial fluid specimens in large retrospective studies, but the investigators may not have performed extensive testing for Mycobacterium spp.

Mycobacterium avium complex has not been previously isolated from a horse with septic arthritis. However, acid-fast stains and culture techniques for mycobacteria are not routinely performed and may not identify mycobacteria even if present. In the horse reported here, acid-fast stains and mycobacterial cultures were performed because of the unusual giant cell synovitis detected histologically. Although it is possible that the organism was a contaminant, it is also unlikely because of the techniques used to prepare the joint prior to arthrocentesis and surgery on different days and the histologic lesions that were compatible with mycobacterial infection (granulomatous inflammation with giant cells) prior to surgery.

This horse had unusual clinical signs that were not typical of other horses with septic arthritis. High rectal temperature was not observed prior to or during the horse’s stay in the hospital. The clinical signs appeared to be more consistent with a degenerative joint disease, but arthroscopy revealed a large amount of fibrin and synovial proliferation with minimal articular cartilage damage, which are gross lesions not typical of degenerative joint disease. Furthermore, histopathologic lesions of chronic degenerative joint disease typically include primary articular cartilage lesions with minimal synovitis (usually lymphocytic), not the granulomatous and proliferative synovitis with giant cells seen in this horse. Palmar synovial proliferation into the distal portion of the radius rarely occurs with degenerative joint disease or septic arthritis. Villonodular synovitis, a traumatic synovial lesion more common in the metacarpophalangeal joint of horses, can also cause excessive synovial proliferation. However, histologic lesions typical of this disease, including hemosiderin-filled macrophages that indicate previous hemorrhage, various stages of granulation tissue, and abundant proliferation of synoviocytes, were not seen.
Although there are no similar previous reports in horses, chronic corticosteroid administration may have resulted in immunosuppression of the joint defenses and contributed to infection with M. avium complex. Although there are no similar previous reports in horses, similar human cases exist.12,13 For a diagnosis in these cases, surgical synovectomy was required. In other cases of synovial infection with mycobacteria, a history of trauma to the joint was reported. Radiography revealed erosions, osteolytic lesions, and narrowed joint spaces. Mycobacterium avium complex has been identified as the cause of osteomyelitis or septic arthritis in immunocompetent human patients without predisposing causes.14,15

In general, the diagnosis of infection with M. avium complex is established via bacteriologic culture of biopsy material, feces, or blood.17,18 An acid-fast stain can sometimes identify mycobacteria, but the inability to identify acid-fast organisms in biopsy specimens or body fluids (as reported here) does not rule out mycobacterial infection because the organisms can be present in very low numbers.17,18 Typically, mycobacterial infections induce granulomatous inflammation with or without multinucleated giant cells in the infected tissue. Granulomas are often found via necropsy of horses with intestinal lesions. In the horse reported here, histologic examination revealed granulomatus synovitis with multinucleated giant cells, which are histologic lesions compatible with mycobacterial infection.

Treatment for M. avium has not been attempted in horses because of rapid deterioration in the horses’ condition.19,20 In a horse in which Mycobacterium smegmatis was isolated from a subcutaneous abscess located cranial to the right femoropatellar joint, the abscess resolved after surgical removal of the abscess and antimicrobial treatment with trimethoprim-sulfonamide and enrofloxacin.21

Unfortunately, the infection was not identified until after the horse was released from our hospital. Early recognition, possibly via synovial biopsy and culture methods targeted for mycobacterial infection, is important and could lead to aggressive and appropriate treatment,22,23 which could improve the long-term prognosis. Local treatment in the affected joint is a potential option, but no reports on regional perfusion or intra-articular treatment with commonly used medications are available. Veterinarians should consider infection with M. avium complex in horses with localized chronic, progressive arthritis associated with granulomatous synovitis with giant cells.

References